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A DESIGN FOR AN APPARATUS FOR PNEUMATIC TREATMENT IN HOSPITALS.

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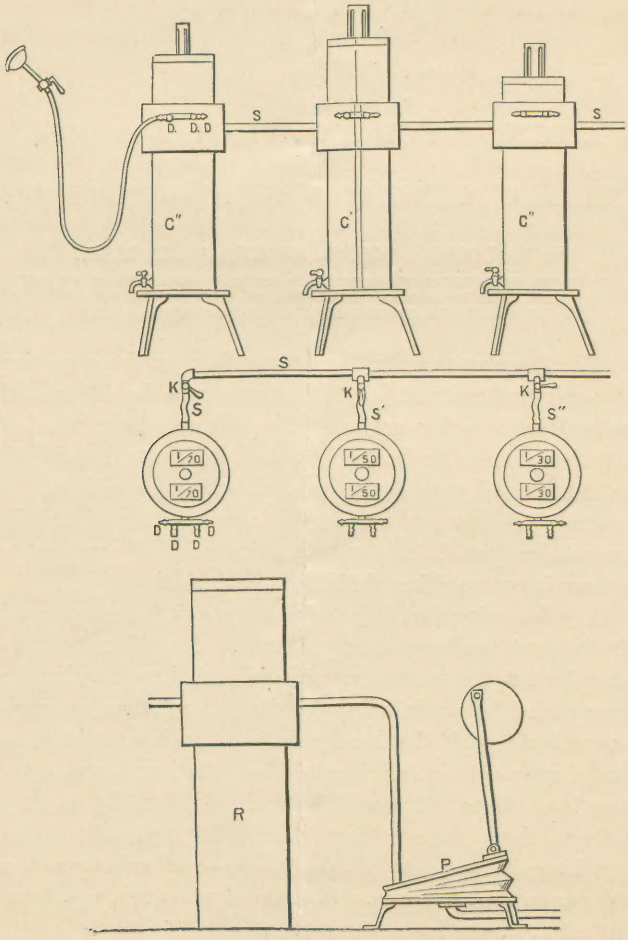
For the proper utilization of the therapeutic properties of condensed and rarefied air, according to the differential method, in hospitals or institutions where a large number of patients are to be treated, it is desirable that there should be constructed at moderate cost an apparatus with which several patients may be treated at one time, but which will nevertheless permit of accurate adjustment of pressure to the varying necessities of different individuals.

The following sketch is for an apparatus for compressed air to treat twelve patients at once. As each patient inhales for but ten to fifteen minutes, and then rests for the same period before inhaling for the second time, seventy-two patients could be treated during two hours with this size of apparatus, so that it would be quite large enough for most institutions. It would be used, say, for fifty or sixty patients about three to four hours daily, as most patients would require two sets of inhalations—one in the morning and one in the afternoon. It could thus be run, say, from 9 to 11 A. M. and from 3 to 5 P. M.

C, C′, C″ are gasometers slightly modified from Waldenburg's—such, indeed, as employed in the Cohen-Richardson apparatus—except that, instead of being fitted with but one



delivery-tube, each has four delivery-tubes, D, D, D, D, and the size of the cylinder is correspondingly increased.* C is weighted at the bottom for a pressure of $\frac{1}{80}$ of an atmosphere, and additional weights may be placed atop to bring the pressure up to $\frac{1}{40}$ of an atmosphere. C′ is weighted for $\frac{1}{60}$ atmosphere, and the pressure may be increased to $\frac{1}{50}$ atmosphere. C″ is weighted to $\frac{1}{40}$ atmosphere, and the pressure may be increased to $\frac{1}{30}$. S is a supply-tube with branches, S′, S″, S, leading to a reservoir, R, into which air is pumped from the outside atmosphere (pure air) by a pump or bellows, run by an electric motor or any other source of power. The power required will be between one quarter and one half horse-power. This reservoir is weighted to give an air pressure greater than any used in the cylinders, C, C′, C″, and will always force air into them.

When the reservoir is full, it can be adjusted to stop the pump or bellows, either by opening a switch if an electro-motor be used, or by interrupting the mechanical connection if the source of power be a steam-engine or other motor.

Valves in each of the cylinders, C, C′, C″, controlling the connection between R and the gasometers, are so arranged as to automatically regulate the ingress of compressed air into the latter, so that when the air-cylinders have fallen to the lowest point, the valves are open to their full extent, and, as the cylinders rise and reach the proper point, the valves are closed and the air-supply cut off. When a gasometer is not in use, the air-supply is cut off by the stop-cock, K.

A warming apparatus can be interposed between the pump, P, and reservoir, R, when the weather is too cold to use the air at the prevailing temperature.

* The air cylinder of the Cohen-Richardson apparatus for home use, as now constructed by Richardson & Metzgar, of Philadelphia, and Codman & Shurtleff, of Boston, is 8 inches in diameter and 24 inches high.

Apparatus for drying or moistening the air, if necessary, may also be interposed at any desired point between the outer atmosphere and the patient. The gasometers, as in the ordinary Cohen-Richardson apparatus, have hook and sponge attachment for volatile medicaments, or special medication for the individual patient may be secured by interposing any appropriate medicating apparatus between the gasometer and the mask covering the face of the patient.

As many gasometers may be brought into communication with the reservoir as may be desired, and, if necessary, five delivery-tubes for patients may be connected with each gasometer. The gasometers may be arranged for any fixed or adjustable pressure desired. Of course all the patients using the same gasometer at the same time will inhale air at the same pressure. It is believed that the arrangement of pressures here suggested will meet ordinary requirements among the number of patients for which the apparatus is calculated. Patients beginning treatment would require $\frac{1}{80}$ to $\frac{1}{70}$; those who had become accustomed to it would need from $\frac{1}{60}$ to $\frac{1}{40}$; exceptional cases would be benefited by $\frac{1}{30}$.

Should a fourth cylinder be introduced, it might be permanently weighted for $\frac{1}{60}$, and furnished with additional weights up to $\frac{1}{30}$. Of course, if a cylinder is permanently weighted for any pressure whatever, that pressure may be increased to any amount desired; or, as in the ordinary apparatus for home and office use, each cylinder may be permanently weighted to $\frac{1}{70}$ only, and furnished with weights up to $\frac{1}{30}$. The sketch merely gives a general plan, capable of modification as required.

To supply three gasometers in constant use by twelve patients, estimating that the patients average ten respirations each per minute, and inhale on the average 200 cubic inches of air each at each inspiration—*i. e.*, that from the three

gasometers 24,000 cubic inches of air are delivered a minute, at an average excess pressure of $\frac{1}{60}$ of an atmosphere, equal to 24,400 cubic inches at ordinary pressure—the reservoir, R, would not have to be larger than about 12 inches in diameter and 36 inches in height. Any form of bellows or pump can be used that will give sufficient air.

For intermittent use these figures can be reduced. I am indebted for revision of the calculations to my friend and co-laborer in pneumatics, Mr. Charles H. Richardson, of Philadelphia. Messrs. Richardson and Metzger estimate the cost of such an apparatus at from $340 to $400, according to the size of electric motor and the distance of the cylinders, C, C′, C″, from the reservoir. Where the motive power already exists, as in most hospitals, the cost of motor would be saved, say, $75 to $100.

In situations that can be reached by the wires of electric light and power companies, an electric motor would probably be the best, and the rental would not exceed $5 a month.

If desired, apparatus for expiration into rarefied air may be combined with this at a small proportionate advance in cost. As it is not right to exhale into the same cylinder from which inhalation is made, separate gasometers, counterpoised, should be provided for the purpose, and connected with a large reservoir or a reservoir and pump. The pump would be supplied from the reservoir and discharge into the outer air.

The effects of expiration into compressed air may be obtained, as described in this journal for December 3, 1887, p. 626, by attaching to the face-mask or its stop-cock one of the "resistance-valves" made for me by Messrs. Codman & Shurtleff, of Boston. Increasing experience in the treatment of pulmonary troubles, and especially phthisis, with inhalations of compressed air, more than confirms the opin-

ions previously expressed as to the great value of this method and as to the possibility of securing its best effects with the simplest apparatus. The time required with an instrument that can be used by but one person at a time has been a great obstacle in the way of introducing the method into public institutions. It is hoped that this obstacle will now be overcome.

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